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Public and Legislative Session Summaries

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Editor's note: The following summaries of the presentations made at the Public and Legislative Sessions were prepared by Nancy Read, Research Scientist with the Minnesota Mosquito Research Program, from taped or written versions of the talks. Extensive summaries are provided of the remarks of those presenters who did not make formal presentations at the Technical Session. Edited transcripts of the Legislative Issues and Implications panel discussion were edited by Ms. Read from verbatim transcriptions of the taped proceedings prepared by Kathy Briesemeister.

Nancy Read completed her M.S. in entomology at the University of Minnesota in 1984 and is planning a Ph.D. on mosquitoes. She received a B.A. in biology from St. Olaf Collage (Paracollege), Northfield, in 1980 where she concentrated on invertebrate biology, wetlands ecology, and the history of ecological thought. Ms. Read is originally from upstate New York.

Kathy Briesemeister, MMRP secretary, received her B.A. from St. Cloud University in 1980.

Public Session

Everything You Should Know About Minnesota's Mosquitoes

Ron Lawrenz (Aquatic Biologist, Minnesota Department of Natural Resources, Ecological Services Section) talked about mosquitoes as a part of life in Minnesota and described their habitats and biology. (Please see Roger Moon's paper from the Technical Session for coverage of this material.) He described how draining a permanent marsh can lead to a change in mosquito species, from cattail mosquitoes (which to do not carry disease) to temporary water breeders (*Culex tarsalis, Aedes vexans*), which may carry disease or be more widespread pests.

Getting Personal: What You Can Do To Avoid Being Bitten

Dave Noetzel (Extension Entomologist, University of Minnesota, Department of Entomology) described some of the ways mosquitoes are attracted to humans and discussed many ways to avoid being bitten:

The most obvious way to avoid being bitten is to go somewhere where there are no mosquitoes. Some animals stand in water or on breezy hilltops; people can go inside their screened houses. Window screens are very effective and cost around $5 per person per year. (Window screens were once the major contributor to controlling malaria in the United States.) People can choose to avoid going outside at times of highest biting pressure (evenings). Sonic devices are ineffective for mosquito control. On a personal basis, neutral clothing (at about $2.50 per year) and repellents based on DEET are effective. Other moderately effective repellents include bracken fern and Skin-So-Soft®. Natural sugar and Vitamin B_1 are not effective as oral repellents (although Vitamin B_1 has some repellent activity if spread on surfaces). For small area control (i.e., backyards), citronella candles or repellent coils are moderately effective, and such products as Raid or Malathion (applied with a fogger) can be effective. Napthalene granules have a limited effect. Homeowners can work to limit breeding sites (such as tires, cans, ditches) in their yards, but other forms of larval control are probably not cost effective on a yard-by-yard basis and should be done regionally. Bug zappers are a $100 million per year business and are worthless for controlling mosquitoes. While it's true that they kill many insects, only a small proportion of these are mosquitoes, and not enough to affect the total mosquito population. The same problem is true for such natural predators as purple martins and bats; they consume some mosquitoes but are not effective in mosquito control.

Metropolitan Mosquito Control District Programs and Finances

Robert Sjogren (Ph.D., Director, Metropolitan Mosquito Control District) described the current Metropolitan Mosquito Control District (MMCD) program and its plans for the future:

Physical control has not been used in the district (except by private land owners) due to the desire to maintain natural areas for wildlife and for esthetic reasons.

Biological control possibilities were studied extensively in the late 1970s. Most invertebrate natural predators occur in permanent water sites, which produce relatively few mosquitoes. Few native natural enemies occur in the intermittant water sites, which produce most mosquitoes. Currently there

are no commercially available biological organisms that will maintain themselves from year-to-year in Minnesota and will substantially control mosquitoes.

To use chemical control methods, breeding sites must be inspected at regular intervals or following each rain that triggers a new hatch of eggs. When inspection finds mosquito larvae present, materials must be applied to the breeding sites when the immature mosquitoes are at the stage susceptible to the material used. The need for repeated inspection and application makes chemical control quite labor intensive. While use of physical or biological control methods is preferable to the use of chemicals, the absence of envrionmentally suitable physical control and dependable biological control methods leads to reliance on chemical control materials that achieve dependable results.

Several new control materials have recently become available. Use of the soil bacterium *Bacillus thuringiensis israelensis* and the insect growth regulator Altosid has made possible a reduced impact on non-target invertebrate fauna. Much remains to be learned about these impacts, but they are clearly less than those of the petroleum, organophosphate, or carbamate insecticides previously used in larval control. Current evidence indicates that, because of the insecticides' short half-life, when older chemicals are replaced with new, low-impact materials, species previously affected will recolonize treated areas.

Cost of control measures used by MMCD varies with the size of the area treated and the frequency of application required to maintain control. For larval control, frequency is a function of the material's control duration and the number of treatments needed each season. For adult control, the frequency is determined by control duration and rate of adult mosquito infiltration from uncontrolled rural areas. Infiltration is affected by both adult mosquito population density and uncontrolled breeding grounds.

The table below compares material and labor costs on a per acre per year basis for larval control materials used in ground applications by the MMCD. This is based on six broods per season; historically, the number of broods has ranged from 3 to 14.

Material and labor costs for larval control materials used in ground application by the MMCD.

Material	Treatment Cost Per Acre Per Year	Acres Controlled Per Worker Per Year
Abate granule	$108	36
Malathion granule	100	36
Dursban granule	94	84
BTI granule	116	36
Altosid briquet	134*	500

* Additional broods are controlled at no further expense; for other materials, costs would increase proportionally with additional broods.

Adult control is limited to cold-fog applications of Resmethrin. The cost of this treatment, applied at quarter-mile intervals in open country (0.24 fluid oz/acre), is $0.09/acre. In wooded areas, the cost is $0.53 per acre.

The potential for disease transmission and/or mosquito annoyance at any particular location in the metro area is determined by the following factors: 1) mosquito species involved, 2) distance inside the perimeter of the larval control area, 3) number of wooded daytime adult mosquito resting (harborage) areas in the neighborhood, 4) prevailing evening breeze direction and relative humidity level in the past ten days, 5) number and productivity of uncontrolled breeding sites located within flight range of the adullt mosquito, 6) number of days since the last mosquito brood emergence, and 7) control programs (i.e., Tier I or Tier I and II) in effect in the county. [NOTE: Please see the remarks of Representative Skoglund in the Legislative Issues and Implications panel discussion for an explanation of Tier I and Tier II taxation systems.]

Two studies to evaluate the effectiveness of control measures were done — one by Mr. John Genereux as part of the 1977 MMCD Environmental Impact Statement and one by Dr. Robert Sherman — to evaluate the effectiveness of the Minnetonka Project. Genereux presented seven different approaches to the subject. In one, the term "denied time value" was coined and extrapolated to a measure of citizen willingness to pay. In 1976, interviews were conducted with about 1,800 residents during the mosquito season. During the survey (which coincidentally was conducted in a very dry summer, the lowest year on record for mosquito populations), the median willingness-to-pay response was $10. The report commentary indicated that if follow-up surveys were conducted, they would probably result in higher estimates, especially if taken in a year with higher mosquito populations. Subsequent responses in 1982 and 1983 by residents of Minnetonka (an area with a notably high income level) showed a much higher willingness to pay, given that satisfactory control was achieved.

Benefits of effective mosquito control can best be addressed by studying citizen response and interpreting the values placed on being able to more fully enjoy the outdoors during the relatively short summer season. The cost/benefits associated with improved mental health, disease prevention, and business sector impacts need further study.

A number of significant advances have been made by MMCD in its efforts to improve *Aedes vexans* control by developing more cost effective and environmentally compatible methods. The control aspects expected to successfully reduce the impact of mosquitoes on the outdoor summer activities of Twin Cities residents include: 1) increased public awareness of the nature of the problem, 2) development of the controlled release Altosid briquet, 3) computer management of field data bases, 4) regional 3,000 square mile monitoring of adult mosquito populations on a twice-weekly basis with three dimensional graphic plots, 5) development of control capability on cattail mosquito populations, 6) correlation of plant indicator species with mosquito larval production levels, 7) correlation of rural animal concentrations with adjacent high larval production areas, 8) availability of Altosid briquet aerial application capability for large areas, and 9) undertaking the five-year project to develop a "regional computerized mosquito management model" to determine the most cost-effective control strategies to employ in the district program

Definitive studies are needed on the role of mosquito dispersal as it influences regional mosquito populations. Little data is available on how environmental and behavioral factors regulate mosquito populations over their lifespan.

The future thrust of mosquito control must be toward greater understanding of the environmental factors influencing mosquito development, their role in environmental dynamics, the effects of available control materials on local fauna, and greater emphasis on the development of more cost effective and mosquito-specific regional control strategies.

Environmental And Public Health Tradeoffs

Rosemary Mackay (Ph.D., University of Toronto, Department of Zoology) described aspects of the ecology of temporary pools, where many mosquitoes breed. (Please see Dr. Mackay's paper in the Technical Session):

The organisms living in these pools must be able to deal with many adverse conditions, tend to be very resilient and are perhaps less susceptible to pesticides than organisms from purer water. Because of this resilience, it may be very difficult to effectively kill mosquitoes, suggesting that screens and repellants might be a better approach.

Mosquito Control and Wildlife — Is There a Conflict?

James B. Elder (Ph.D., Regional Contaminants Specialist, U.S. Fish and Wildlife Service) said that, in the past, there has often been a conflict between mosquito control and fish and wildlife needs since all too often mosquito-producing habitat is also fish and wildlife-producing habitat:

Methods used to reduce or eliminate mosquitoes may also affect fish and wildlife either directly or indirectly by damaging habitat. Physical control methods (such as drainage of wetlands) often represent an unacceptable loss of habitat. This leads to a reluctant acceptance of pesticides for mosquito control.

Compared with conditions that prevailed until about 1970, great strides have been made in "pesticide sanity." New pesticides are subject to stringent testing, and use regulations have helped curb misuses. Some pesticide-related fish and wildlife losses still occur, but their levels are minuscule compared with those of the past.

Is controversy over pesticide use still justified in this day and age? Some vocal critics of pesticides may have failed to keep abreast of advances in pesticide technology, but many who do keep abreast of technical developments share the concern. While hazardous waste constitutes the major portion of toxic substances entering the environment, only with pesticides do we deliberately introduce substances for the purpose of killing living organisms.

Many people are concerned about the toxicity of pesticides, but to the fish or wildlife biologist the main concern is hazard — the probability that organisms other than the target pest will be harmed by a given pesticide application. Laboratory studies of toxicity are useful but do not say much about how toxicity will be manifested under field conditions. Toxicity and hazard may vary with season, weather, habitat, formulation, and manner of application.

The pesticides in use today are more selective and used more selectively than those of the past. However, serious questions remain unresolved concerning impacts on fish and wildlife and their invertebrate food base. Organized mosquito control districts have been willing to discuss these concerns and make program adjustments. The greatest problem is with local "do-it-yourself" operations, where, even with competent and legal applications, fish and wildlife kills can occur due to lack of even rudimentary hazard assessment. The obligation of federal or state fish and wildlife agencies is to ensure that environmental consequences are recognized as part of the costs of mosquito control.

[NOTE: The following was excerpted from Dr. Elder's comments during the Public Session panel discussion.] Grand Forks was the classic misapplication of all time. [In May, 1969,] it was 105° in Grand Forks. Mosquitoes were really [hatching].... [The Public] understandably went to [city officials, asking them to] get rid of those mosquitoes. The worst area seemed to be about a 1,500 hundred acre block of wooded area, and [the city] contracted with a man to come in with a helicopter to spray that area. As far as we can tell from the follow-up, he put down the exact amount of material (Fenthion) that he was supposed to, [according to] the label.... What he forgot to do was to consult with some of the people at the university there who could have told him, first of all, that he was using a chemical that is differentially toxic to birds; to this day we don't know why it kills birds more so than it does other things. Second, it was the peak of the warbler migration. Warblers are treetop gleaners, and when [the city] ran that helicopter over the tops of those trees with this [particular] chemical it rained birds for a day. Something like 25,000 dead birds were picked up there. This was the classic case; if they'd only done it the week before, the week after, used a different chemical — any of a number of things — there wouldn't have been that problem. Fenthion is still registered; it's a good mosquito control chemical but it has such a narrow margin of safety...This chemical is not used by the MMCD.

Legislative Session

Magnitude of Minnesota's Mosquito Problem: Feasibility of Expanded Control Programs

Max Meisch (Ph.D., University of Arkansas, Department of Entomology) discussed the feasibility of expanded control programs in Minnesota:

Mosquito control in the United States is a $70 million per year business. Most control efforts are grassroots — community organized. The metro program here is looked up to as one of the best and most progressive in the country. That points out the feasibility of mosquito control in the state — it will certainly work. But control in major urban areas, such as New Orleans, Minneapolis/St. Paul, or Dallas, may be quite a bit easier than control in smaller agricultural communities of

40,000 people. For one thing, mosquito control is expensive and requires a good tax base to work from. Also, smaller cities are more immediately surrounded by mosquito breeding areas; there's no buffering due to acres of concrete.

Important questions need to be addressed concerning the impact of mosquitoes on human health, livestock, and tourism. Setting up a surveillance system and choosing a threshold for human comfort are also difficult problems.

Minnesota contains three major biomes, each with different mosquito problems; feasibility will come from delineating these areas of study through research. The techniques and plans for doing this are laid out well by the Minnesota Mosquito Research Program.

[Possibilities for biological control are discussed in Dr. Meisch's paper presented in the Technical Session.]

Reaction Panel

Rosemary Mackay (Ph.D., University of Toronto, Department of Zoology) suggested that we consider the psychology of our response to mosquitoes:

There's an emotional hysteria, encouraged by the media, about mosquitoes. We could do a great deal to relieve this hysteria and save money by being more realistic and tolerating mosquitoes, using repellants, and sitting in screened porches.

Ron Lawrenz (Aquatic Biologist, Minnesota Department of Natural Resources, Ecological Services Section) supported the idea that wetlands are valuable for their own sake; ducks are not the whole picture:

In Minnesota, mosquitoes are produced in isolated pockets in our glacial topography. Because of this isolation, these little islands of habitat may also be producing organisms unique to that pond. For that reason, it is important that we look at what we're affecting before we go in and do the work.

John Washburn (Director, Minnesota Mosquito Research Program, Minnesota Department of Health) pointed out that the MMRP proposal offers great potential for increasing our knowledge about wetland ecosystems, as well as public and animal health, quality of life, and possibilities for economic development.

Legislative Issues and Implications — Panel Discussion

MODERATOR: Robert Binger, Burlington Northern, President of Natural Resource Division, retired.

PANEL MEMBERS: Wes Skoglund, Representative, Minnesota Legislature; **Steve Thorne,** J.D., Deputy Commissioner, Dept. of Natural Resources; **Darby Nelson,** Ph.D., Representative, Minnesota Legislature; **John Washburn,** Director, Minnesota Mosquito Research Program, Minnesota Dept. of Health.

Skoglund: From a legislative perspective, the major issues associated with mosquito control are, one, is it feasible, and two, can we afford it. Today I'd say at least half the legislators do think it's feasible to do or is worth exploring. In looking at the state as a whole, the cost/benefits of current methods (the use of screening, air conditioning, repellents, and insecticides) or taking the risk are not very good. For the one control program we have in the state — the MMCD — there are mixed results because we really don't put enough effort (i.e., money) into the program. We have a two-tier taxing system in the seven county metropolitan area. We have a base tier that all of the counties levy that is about 3/10 of a mill. We then allow counties to levy above that, up to 6/10 of a mill. Hennepin County, the only county that chooses to participate in the second tier of the program, levies the 3/10 for the district as a whole and then also levies 3/10 of a mill for itself for extra protection. We have about a third fewer mosquitoes in Hennepin County than does the rest of the metropolitan area. It is cost effective that way. The problem is a third fewer mosquitoes is not enough for us to be comfortable. How much control is worthwhile? I think the standard that's been mentioned of two landings per five-minute period is a worthwhile goal. I also think it's an attainable goal.

What are the economic benefits of mosquito control on tourism? I think the benefits would be just absolutely enormous. There's no other state in the Union that advertises its worst pest. Does mosquito control pose a significant threat to the environment? I'm going to give you a double answer here. I believe the homemade methods, which go on and which will go on unless we try to control them professionally, are dangerous to the environment. Every house has cans of Raid and Yard Guard and all kinds of other insecticides and repellents, and their improper application and improper disposal, I feel, really do pose a threat to the environment. I think that we are all far better off if we have the materials applied by a group like the MMCD. According to MMCD, there were nine times as many chemicals in a can of one of those products than they would apply to my backyard to control mosquitoes there. Are we really better off when we have amateurs like me walking around spraying cans we bought because they had the best advertising or because they happened to be on sale? Secondly, we have to remember that human beings are part of the fauna in our state. Shouldn't we, the government, attempt to provide a little bit better protection for our citizens, especially our youngest citizens who are most susceptible to disease and infection from mosquito bites? And, finally, what

are the future legislative initiatives necessary in regard to mosquito control? There are only two that I see coming up in this session of the legislature. One would be to raise the cap we have on how much we allow the counties to tax for mosquito control. [Also] I think it's very important that the Legislature fund this mosquito study program. I think that it is a study program that, from any point of view, people could respect.

Thorne: I'm a professional skeptic when it comes to manipulations of the environment. I've seen too many [plans] that have come to us with glowing recommendations but have missed one crucial point that was discovered in five years, ten years, 50 years; and we're left with the disastrous results. Let me hasten to say that I am not against controlling mosquitoes. But I have serious questions about whether we really will demonstrate a significant economic impact on, for example, tourism. We are running campgrounds at full or nearly full capacity every weekend all summer in Minnesota [and] I don't think anyone's going to fund us to build a lot more campgrounds. Maybe people aren't coming to Minnesota because we have [restricted] fishing hours [so we won't] destroy our fishing resource. What is the critical factor?

I am very much supportive of the proposed study and research. But I'm skeptical for another reason. We've made the point repeatedly that before you engage in an extensive control program on lands that were set aside for the management of natural resources — for the preservation and enhancement of wildlife — at least give us some evidence that you are not imposing a long-term impact on the base of the food chain. We support what's being proposed but we are concerned that an adequate portion of the budget and the research program be addressed to that kind of question. We're happy that this program is being developed and we will cooperate, but we remain somewhat skeptical because we think that there is a strong push for an immediate and much more aggressive mosquito control program than the facts justify. We hope that the people of Minnesota and the mosquito control interests are willing to wait until adequate data are in.

Nelson: Representative Skoglund identified what he felt were two issues — first, is it feasible to control mosquitoes; and second, is it affordable. I think there's at least one more question, a significant one, and it has to do with impacts. I appreciated Dr. Sjogren's comments as he began his talk when he said, essentially, databases are really important. Before I can get excited about a control program, I need to know some things about the potential impact on ecological systems. One thing that I hope we've learned since at least 1970 is the fundamental inter-relatedness that characterizes ecological systems. It is not even theoretically possible to reach into a system and pluck mosquitoes out without impacting many, many other creatures in the system. I guess I'm skeptical. There are simply too many unanswered questions for me to advocate the sort of aggressive posture that I see us taking. I guess that's the biologist in me coming out.

I'd like to let the politician portion of my being emerge next. It's easy, I think, to get agreement among the folks out there against mosquitoes; nobody likes to be bitten by mosquitoes. As a result it's relatively easy — or at least it appears to have been — to develop a constituency that is willing to pay money to rid themselves of those obnoxious pests. But there isn't a large readily-mobilizable natural constituency for the kinds of fundamental research that I think has to be done before we can seriously consider an aggressive control program. I sit on the Environment Committee and we have just heard a report from a group of folks that says the resource base that supports hunting and fishing in Minnesota simply can't be stressed anymore. If we're going to continue to advertise for more tourists, we've got to look carefully at the fisheries resource base and perhaps try to do our best to improve the carrying capacity of that base.

I think prudence clearly suggests that we pay more attention to collecting basic information. I think we ought to be directing a substantial portion of our mosquito control dollars simply at basic research so that we can attempt to develop some answers to these questions. Cost/benefit analyses scare me because so often it is difficult to quantify some significant variables and they tend to be ignored or forgotten. Finally, we've heard reference to a mosquito study program that is part of what's before us on the legislative agenda this year. In so far as that program is going to be directing its money at answering some basic ecological questions, I'm very supportive. But, if what we're talking about is the bulk of that money simply [being used to increase our] understanding of the mosquito itself and its distribution patterns and all the rest — not directed to developing basic information but essentially to helping us implement an aggressive control program — then I have problems with it.

Washburn: In response to Mr. Nelson's concern, the plan and the legislation as it has been proposed reflect very strongly an orientation toward basic research on not only mosquitoes but also on the aquatic invertebrates and vertebrates, those members of the food chain that would be affected by any control. Dr. Michael Osterholm (chair of the Working Group and state epidemiologist) was asked the question, if it comes down to a decision between wildlife or the environment or some deleterious effect on the food chain versus mosquito control, how are we going to make that decision? His answer was, if we are forced into making that decision, we've failed in our mission in our research proposal

Binger: *We talk about tourism and the adverse effects of mosquitoes, yet one of the problems of the BWCA, a major mosquito area, is controlling the number of people. What is the evidence that mosquitoes reduce tourism?*

Skoglund: Mr. Thorne suggested that we'd do more for tourism in the state if we improved our fishing. I agree with him. Fishermen and fisherwomen are going to come if the fish are biting even if the mosquitoes are biting. But not everybody who comes to Minnesota as a tourist comes to fish. The new resorts that seem to be making it are the ones with the golf courses and tennis courts and so on. I think we have to look beyond the traditional sportsperson as a Minnesota tourist.

Binger: *Do we have data from anyplace that spraying an area like Minnesota during a favorable mosquito weather year would significantly lower the population of mosquitoes?*

Skoglund: We have data on Hennepin County versus other counties, and, if I recall correctly, we have a third fewer mosquitoes in Hennepin County than we do in the adjacent counties that have mosquito control programs. We spend twice as much money or have twice as much control. It is demonstrated that control programs do or have worked. There have also been a couple of demonstration programs in the metropolitan area where they've attempted to take very bad areas and turn them into very good areas. One was in the Minnetonka-Deephaven area. I believe there were 20-30 landings per five minute period before this demonstration was done, and they got it down to 0-2 landings per five minute period. They also did one up in Roseville, and I have a number of letters in my file thanking the MMCD for the demonstration.

Nelson: That's a question that I've often raised in my own mind. When we rate mosquito control by the reduced number of landings per unit time, is that the appropriate measure? I know that there are certain times of the day that mosquitoes are especially bad when I'm out in my garden. You could reduce the number of mosquito contacts by 85% on some of those nights and I'd still go into the house; I'd still concede that chunk of the early evening to those creatures.

Binger: *What independent organization or agency should oversee the environmental impact research to provide an opinion and certify that the work being done will accomplish what is intended and that the results do in fact address the purpose of the research?*

Washburn: The advisory groups that we've assembled will continue to be involved in the process of setting up the research. In addition, we will set up a Scientific Review Committee to review the competitive grants program and also to be involved in review of the research that's conducted at the central research facilities and the field stations.

Thorne: So far as the overseeing and reviewing of the environmental impact work is concerned, we think it is extremely important that the group that is chosen be truly representative of all interests involved. I think it's important that there be a group established that has directly authority to oversee the ongoing research that is, in fact, fairly representative of all sides of the issue. I'm not suggesting that the Health Department's not going to do that, but it's so[illegible]g we're going to be particularly interested in.

Binger: *Are mosquito-eating fish available through DNR? What counties would be eligible? Would there be a cost? How would the fish be delivered into the area? Would a medium-sized lake benefit from this treatment?*

Thorne: The answer is no, we're not raising them in our hatcheries and we don't intend to until a lot more questions are answered about whether they would be an appropriate or feasible means of control in Minnesota.

Binger: *What about controlling mosquito-vectored diseases by vaccines? A vaccine is used for heartworm in dogs. [Ed. note: The prophylactic treatment for dogs is a drug, not a vaccine.]*

Washburn: Very little work has been done on encephalitis vaccines in humans. There is quite an effective vaccine that's offered for horses. If you think that development of new repellants is an expensive and lengthy process, the development of a vaccine is many times more complicated and extremely expensive. Also, we have to keep in mind that although they are significant diseases in Minnesota, [mosquito-vectored diseases] have a relatively low incidence compared to chickenpox, for example, for which a vaccine is currently being developed for children. It's a tremendous cost for a relatively small number of cases.